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(54) **Vane-type fluid machine**

(57) A vane-type fluid machine capable of mechanically moving a vane and of producing a high compression ratio is provided, which includes: a casing having a contacting-surface circular arc on an inner periphery thereof; a rotor eccentrically fitted in the casing with a predetermined eccentricity, having a diameter to form a sealing surface with respect to the contacting-surface circular arc for keeping seal between a suction side and a discharge side and the rotor, and having a rotor discharging groove on an outer surface thereof; a vane slidably inserted in a rotor groove formed on the rotor; and a drive shaft inserted in a boss portion of the rotor concentrically with the rotor, wherein, with rotation of the rotor, fluid is sucked into a space formed in the casing and simultaneously fluid in another space formed in the casing is compressed, while being discharged from a discharge hole provided on the contacting-surface circular arc through the rotor discharging groove.

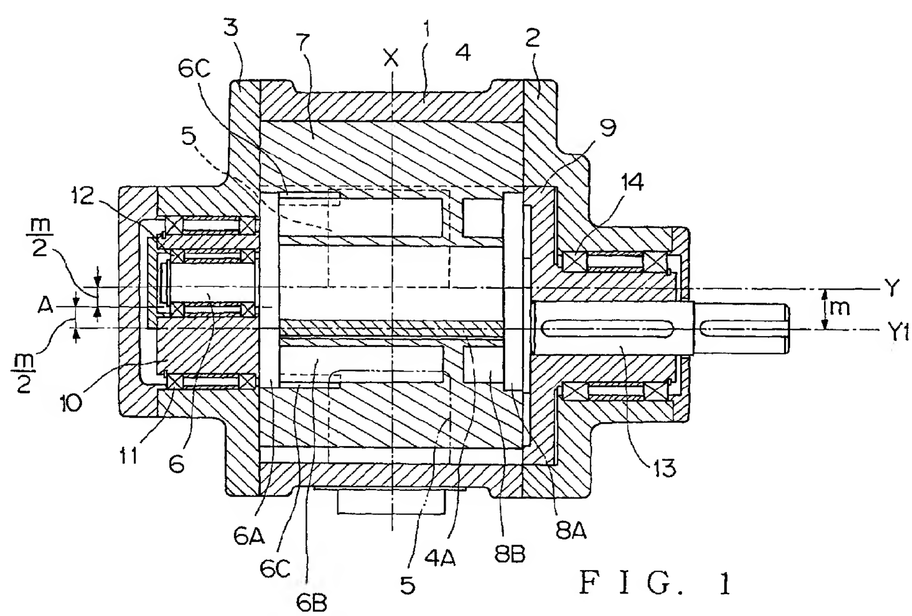

FIG. 1

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention generally relates to **a** vane-type fluid machine such as a vacuum pump or a blower and more particularly, to a vane-type fluid machine which is capable of mechanically moving a vane and of producing a high compression ratio.

2. Description of the Related Art

[0002] In a conventional vane-type fluid machine, vanes are freely inserted in vane grooves formed on a rotor and slidingly move along a casing inner periphery due to centrifugal force by rotation of the rotor so as to suck in fluid between vanes and to discharge the fluid after compression thereof. In case of oil-free construction, the vane needs early replacement because of wear caused by strong friction with the casing inner periphery. And, a high compression ratio can not be obtained with the above conventional vane-type fluid machine in a compression process. Further, as shown in FIG.8, since the casing inner periphery is a circle with a diameter 2Q, if a vane edge-to-edge span 2L is constant, a clearance 2S arises between a vane edge and the casing inner periphery along whole the inner periphery, and practical mechanical performance can not be obtained.

[0003] In case of a oil lubricating vane, lack of a lubricating oil is apt to occur, a metallic contact would arise, and thereby the vane and a rubbing parts is soon worn away. This can be said to is a rubbing portion between a sidecover and the vane. As a result, performance of a fluid machine is lowered. At the same time, big operation noise caused by the metallic contact would become a problem.

[0004] And, lack of a lubricating oil causes stop of operation of the fluid machine. The fluid machine with a oil lubricating vane would have a structure of circulating the lubricating oil, which makes the fluid machine complex, thereby increasing a trouble, and needs a much manufacturing cost. Further, this structure needs exchange of a lubricating oil every one or two years, which needs much maintenance cost.

[0005] For making a oil free structure, though a self-lubricating material would be used in the conventional fluid machine, wear of side ends of the vane as well as a peripheral edge of the vane is remarkable and a noise increases, which requires early replacement of the vane. Also, wear powder enters the fluid, which disturbs a oil free operation and increases a maintenance cost. On the other hand, there would be no good supporting method of both sides of a rotor in a large machine.

[0006] As described above, though the free vane structure has various of problems, the structure with mechanically moving the vane has a great effect of preventing the wear of the vane. However, this structure is not also capable of solving a big problem of producing a high compression ratio with only one rotation of the rotor. Then, in order to get a high compression ratio, a vane-type fluid machine with oil lubricating eight free vanes has been used or serial connection of a plurality of vane-type fluid machines has been applied. Even with these application, a discharge pressure of 2kgf/ C m^2 or a suction vacuum of 50 Toll has been the maximum, and especially getting a high compression ratio has been the most difficult thing to be solved for an oil free vane-type fluid machine.

SUMMARY OF THE INVENTION

[0007] In view of the foregoing, an object of the present invention is to provide a vane-type fluid machine of an oil free type, wherein even a self-lubricative vane is not worn and, further, a high compression ratio can be got with one rotation of a the rotor, and to provide a casing applied to the vane-type fluid machine.

[0008] In order to achieve the above-described object, as a first aspect of the present invention, a vane-type fluid machine includes: a casing with a sidecover, the casing having a contacting-surface circular arc on an inner periphery thereof; a rotor eccentrically fitted in the casing with a predetermined eccentricity, the rotor having a diameter to form a sealing surface with respect to the contacting-surface circular arc formed on the inner periphery of the casing for keeping seal between a suction side and a discharge side and the rotor having a rotor discharging groove on an outer surface thereof; a vane slidably inserted in a rotor groove formed on the rotor so that an edge of the vane proceeds along the inner periphery of the casing on rotation of the rotor; and a drive shaft inserted in a boss portion of the rotor concentrically with the rotor for rotating the rotor, wherein, with rotation of the rotor, fluid is sucked into a space formed in the casing with an inner surface thereof, the outer surface of the rotor, and the vane, and simultaneously fluid in another space formed in the casing is compressed, while being discharged from a discharge hole provided on the contacting-surface circular arc through the rotor discharging groove.

[0009] According to the above structure, the sealing surface between the rotor and the contacting-surface circular arc on the inner periphery of the casing makes sufficient seal between the suction side and the discharge side. And, since the discharge hole on the contacting-surface circular arc and the rotor discharging groove on the rotor enables to produce any high compression ratio surely and easily. Further, since the vane is not slidably but mechanically set on the rotor, a clearance between the vane edge and the casing inner periphery can be freely set to almost zero or very small one at any rotation angle of the rotor by adjusting length of the vane according to material of the vane or temperature of the fluid. Consequently, even if the vane is made

a self-lubricating material such as carbon, wear of the vane caused by centrifugal force does not occur, thereby achieving long life of the vane and simultaneously producing clean compressed fluid not containing wear powder.

[0010] As a second aspect of the present invention, the vane-type fluid machine with the first aspect further includes: an orbiting shaft fitting rotor accommodated in the sidecover on the undriven-side rotatably around an axis positioned in the middle of axes of the casing and of the rotor; and a partition provided on a bottom portion of the rotor groove, wherein the vane slidably inserted in the rotor groove formed on the rotor is made up of a pair of vane members connected by a connecting member keeping a fixed edge-to-edge span of the pair of vane members and having an orbiting shaft outwardly in the center of the edge-to-edge span of vane members, the orbiting shaft being rotatably fitted into the orbiting shaft fitting rotor with half of the predetermined eccentricity and orbiting the axis of the orbiting shaft fitting rotor.

[0011] According to the above structure, in addition to effects based on the first aspect, since the partition is provided in the rotor groove, blowing-out of the fluid from the discharge side to the suction side can be prevented almost completely, thereby getting a high compression ratio surely and easily.

[0012] As a third aspect of the present invention, a vane-type fluid machine includes: a casing with an undriven-side sidecover; a rotor eccentrically fitted in the casing with a predetermined eccentricity; a vane slidably inserted in a rotor groove formed on the rotor so that an edge of the vane proceeds along an inner periphery of the casing on rotation of the rotor; a drive shaft inserted in a boss portion of the rotor concentrically with the rotor for rotating the rotor; and a pin-crank shaft having an eccentricity of half of the predetermined eccentricity and set between an undriven-side end of the vane and the undriven-side sidecover, wherein one end of the pin-crank shaft is rotatably fitted into the vane in its edge-to-edge span center and the other end is fitted into the undriven-side sidecover also rotatably around an axis positioned in the middle of axes of the casing and of the rotor so that an axis of the one end of the pin-crank shaft orbits the axis of the other end thereof with a radius of half of the predetermined eccentricity, wherein, with rotation of the rotor, fluid is sucked into a space formed in the casing with an inner surface thereof, the outer surface of the rotor, and the vane, and simultaneously fluid in another space formed in the casing is compressed, while being discharged from a discharge hole.

[0013] According to the above structure, since the vane is not slidably but mechanically set on the rotor, a clearance between the vane edge and the casing inner periphery can be freely set to almost zero or very small one at any rotation angle of the rotor by adjusting length of the vane according to material of the vane or temperature of the fluid. Consequently, even if the vane is made a self-lubricating material such as carbon, wear of the vane caused by centrifugal force does not occur, thereby achieving long life of the vane and simultaneously producing clean compressed fluid not containing wear powder.

[0014] As a fourth aspect of the present invention, a vane-type fluid machine includes: a casing with sidecovers; a rotor eccentrically fitted in the casing with a predetermined eccentricity; a vane slidably inserted in a rotor groove formed on the rotor so that an edge of the vane proceeds along an inner periphery of the casing on rotation of the rotor; a drive shaft inserted in a boss portion of the rotor concentrically with the rotor for rotating the rotor; and an undriven-side rotor flange concentrically assembled with the rotor on an undriven-side thereof so that both sides of the rotor are rotatably supported by the respective sidecovers through bearings, wherein, with rotation of the rotor, fluid is sucked into a space formed in the casing with an inner surface thereof, the outer surface of the rotor, and the vane, and simultaneously fluid in another space formed in the casing is compressed, while being discharged from a discharge hole.

[0015] According to the above structure, since the vane is not slidably but mechanically set on the rotor, a clearance between the vane edge and the casing inner periphery can be freely set to almost zero or very small one at any rotation angle of the rotor by adjusting length of the vane according to material of the vane or temperature of the fluid. Consequently, even if the vane is made a self-lubricating material such as carbon, wear of the vane caused by centrifugal force does not occur, thereby achieving long life of the vane and simultaneously producing clean compressed fluid not containing wear powder. Further, since the rotor can have rotor flanges on the respective sides thereof and the rotor flanges can be supported by the respective sidecovers, a big capacity vane-type fluid machine with a long casing can be obtained.

[0016] As a fifth aspect of the present invention, a vane-type fluid machine includes: a casing with an undriven-side sidecover; a rotor eccentrically fitted in the casing with a predetermined eccentricity; a vane slidably inserted in a rotor groove formed on the rotor so that an edge of the vane proceeds along an inner periphery of the casing on rotation of the rotor; a drive shaft inserted in a boss portion of the rotor concentrically with the rotor for rotating the rotor; an orbiting shaft fitting rotor accommodated in the undriven-side sidecover rotatably around an axis positioned in the middle of axes of the casing and of the rotor; and an orbiting shaft set between an undriven-side end of the vane and the orbiting shaft fitting rotor, wherein one end of the orbiting shaft is fixedly inserted into the vane in its edge-to-edge span center and the other end is fitted into the orbiting shaft fitting rotor with half of the predetermined eccentricity, wherein, with rotation of the rotor, fluid is sucked into a space formed in the casing with an inner surface thereof,

the outer surface of the rotor, and the vane, and simultaneously fluid in another space formed in the casing is compressed, while being discharged from a discharge hole.

[0017] According to the above structure, since the vane is not slidably but mechanically set on the rotor, a clearance between the vane edge and the casing inner periphery can be freely set to almost zero or very small one at any rotation angle of the rotor by adjusting length of the vane according to material of the vane or temperature of the fluid. Consequently, even if the vane is made a self-lubricating material such as carbon, wear of the vane caused by centrifugal force does not occur, thereby achieving long life of the vane and simultaneously producing clean compressed fluid not containing wear powder. Further, since one end of the orbiting shaft is fixedly inserted into the vane without a bearing, the vane can be thin, thereby increasing a capacity of the casing and reducing a material cost, and this fixed insertion of the orbiting shaft allows easier machining of its hole on the vane, not requiring a severe machining tolerance. Still further, since the orbiting shaft is a straight one, a machining cost can be low.

[0018] As a sixth aspect of the present invention, the above-described vane-type fluid machine includes: a grease reservoir and a grease hole connecting the grease reservoir with the vane are formed inside the rotor so as to lubricate the vane through the grease hole.

[0019] According to the above structure, since a sliding surface between the vane and the rotor groove is large, frictional temperature is not apt to rise, thereby preventing a heat-resistant grease from dispersing and also preventing related parts from deforming or wearing. And, the grease reservoir can have a big capacity, thereby not requiring supply of the grease for a long period, and a structure of pressuring the grease with use of centrifugal force can maintain reliable grease supply, which enables a vane-type fluid machine not to have a oil supply system and not to raise the wear powder.

[0020] As a seventh aspect of the present invention, a vane-type fluid machine includes: a casing with an sidecover, a rotor eccentrically fitted in the casing with a predetermined eccentricity, a vane slidably inserted in a rotor groove formed on the rotor, and a drive shaft concentrically connected to the rotor for rotating the rotor, wherein, on the coordinates (X,Y1) with the origin of an axis of the rotor, a point (Xz,Y1z) on one part of an inner periphery of the casing is determined by the following equations of

$$Xz = (m\sin\alpha+L)\cos(90°-\alpha)$$

and

$$Y1z= (m\sin\alpha+L)\cos\alpha,$$

and a point (Xv,Y1v) on the remaining part of the inner periphery of the casing is determined by the following equations of

$$Xv =(L-m\sin\alpha)\cos(90° - \alpha)$$

and

$$Y1v=(L-m\sin\alpha)\cos\alpha,$$

wherein m is the predetermined eccentricity, α is rotation angle of the vane, and L is half of an edge-to-edge span of the vane.

[0021] According to the above structure, since a clearance between the vane edge and the casing inner periphery can be freely set to almost zero or very small one at any rotation angle of the rotor by adjusting length of the vane according to material of the vane or temperature of the fluid. Consequently, wear of the vane caused by centrifugal force does not occur, thereby achieving long life of the vane, which can reduce a maintenance cost, and simultaneously producing clean compressed fluid not containing wear powder.

[0022] The above and other objects and features of the present invention will become more apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a longitudinal sectional view showing a first embodiment of a vane-type fluid machine in accordance with the present invention;

FIG. 2 is a cross-sectional view of the vane-type fluid machine of FIG. 1;

FIGS. 3 A to 3D are schematic views showing operation of the vane-type fluid machine of FIG. 1;

FIG.4 is a cross-sectional view showing a second embodiment of a vane-type fluid machine with a single vane in accordance with the present invention;

FIG.5 is a longitudinal sectional view showing the vane-type fluid machine having the single vane structure of FIG. 4 and additionally having a drive-side pin-crank shaft structure and a bearing structure of a undriven-side rotor flange.

FIG.6 is a longitudinal sectional view showing a modified embodiment, having a straight orbiting shaft, of the second embodiment of the vane-type fluid machine in accordance with the present invention;

FIG. 7 is a theoretical scheme of a casing inner periphery of the vane-type fluid machine in accordance with the present invention; and

FIG. 8 is a theoretical scheme of a casing inner pe-

riphery of a conventional vane-type fluid machine.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] Embodiments of the present invention will now be described in further detail with reference to the accompanying drawings.

[0025] FIGS.1-3 show a first embodiment of the vane-type fluid machine in accordance with the present invention.

[0026] FIG. 1 is a longitudinal sectional view showing the first embodiment of a vane-type fluid machine in accordance with the present invention, and FIG. 2 is a cross-sectional view of the vane-type fluid machine of FIG. 1.

[0027] Referring to FIGS.1 and 2, a rotor-boss 9 with a bearing 14 is provided in a casing 1 in connection with a rotor 4 which has an eccentricity m with respect to the casing 1 through a drive-side sidecover 2. 6A is a connecting member having a pair of connecting member shafts 6B specifying a vane edge-to-edge span of a pair of vanes 7 to 2L(FIG.3) by inserting the connecting member shafts 6B in insertion holes of the respective vanes 7, and an orbiting shaft 6 is provided on the connecting member 6A in the center thereof. 6C is a rotation preventing key for the connecting member shaft 6B. 8A is an auxiliary connecting member to keep the vane edge-to-edge span 2L along with an auxiliary connecting member shaft 8B. The orbiting shaft 6, having a bearing 10, with the Y-axis orbits around the A-line, i.e. the center of an orbiting shaft fitting rotor 10, with an eccentricity m/2. The orbiting shaft fitting rotor 10 rotates with the A-line through a bearing 11 accommodated in an undriven-side sidecover 3. The vane 7 is slidably inserted in a rotor groove 4B. 4A is a rotor groove bottom partition.

[0028] FIGS.3A to 3D are schematic views showing operation of the vane-type fluid machine of FIG. 1. In FIG.3A, the center of the orbiting shaft 6, i.e. the vane edge-to-edge span center G, is on an intersection point of X-axis and the Y1-axis. An orbital circle h of the vane edge-to-edge span center G has the center of the intersection point T of the A-line and the X-axis and a radius m/2. The orbiting shaft fitting rotor 10 rotates around the intersection point T with twice a rotation speed of the rotor 4. A space F on the left of the vane 7 is in a state of completion of suction, and a space E on the right side of a lower vane 7 is in a state of discharging a highly compressed fluid.

[0029] A contacting-surface circular arc between a casing inner periphery and the rotor 4 has a radius r and a diameter U in order to make a contacting surface distance W (FIG.3). A rotor discharging groove 5 is formed on the compressing side of the vane 7, wherein a long rotor discharging groove 5 produces a low compression ratio and a short rotor discharging groove 5 produces a high compression ratio, and the diameter U and the contacting surface distance W are decided also taking account of a compression ratio. Reference character K indicates a suction hole and D indicates a discharge hole.

[0030] FIG.3B shows a state that both the rotor 4 and the vane 7 have rotated by 45° in a counterclockwise sense, the orbiting shaft fitting rotor 10 has rotated by 90° in the same direction, and the vane edge-to-edge span center G of the vanes 7 has arrived at an intersection point between the A-line and the X-axis on the orbital circle h, wherein a space E is in a compression process. The lower vane 7 has just discharged the compressed fluid from the discharge hole D.

[0031] Referring to FIG.3C, both the rotor 4 and the vane 7 have rotated by 90° in a counterclockwise sense, the vane edge-to-edge span center G of the vanes 7 has arrived at an intersection point between the X-axis and the Y-axis on the orbital circle h, and the vane edges are on the X-axis. In this state, the discharge hole D is completely closed by the rotor 4, and fluid in a space E is compressed to a compression ratio of approximately 1.9. The orbiting shaft fitting rotor 10 has rotated by 180° .

[0032] FIG.3D shows a state that the vane 7 has rotated by 150° in a counterclockwise sense, and the vane edge-to-edge span center G of the vanes 7 has arrived at an intersection point between the vane centerline C and the orbital circle h. In this state, fluid in the space E is compressed to a compression ratio of approximately 6, and the rotor discharging groove 5 is about to open to the discharge hole D. The space F is just before completion of suction.

[0033] With rotation of the rotor 4 as described above, both of the vane edges move along the casing inner periphery R, the vane edge-to-edge span center G orbits on the orbital circle h, and the space F gradually decreases, thereby raising compression ratio of the fluid therein. The vanes 7 are slidably inserted in respective rotor grooves 4B, and a rotor groove bottom partition 4A is formed between the rotor grooves 4B so as to prevent leakage of fluid. The orbiting shaft fitting rotor 10 rotates with twice a rotation speed of the rotor 4 simultaneously with keeping the eccentricity m/2 of the orbiting shaft 6, and clearance, i.e. little clearance or very small one, between the vane edge and the casing inner periphery R does not change at any rotation angle.

[0034] Further, a grease reservoir (not shown) along with a grease hole (not shown) may be provided inside the rotor 4 for lubricating the vane 7 in case of grease lubrication.

[0035] The above-mentioned first embodiment of the vane-type fluid machine consisting of the casing 1, the rotor 4, the rotor discharging groove 5, and the contacting-surface circular arc and the discharge hole D and capable of producing a high compression ratio is applicable to a conventional vane-type fluid machine wherein a vane slides freely in a rotor groove by centrifugal force.

[0036] Next, FIGS.4 and 5 show a second embodiment of the vane-type fluid machine in accordance with

the present invention.

[0037] FIG.4 is a cross-sectional view showing a second embodiment of a vane-type fluid machine with a single vane in accordance with the present invention. And, FIG.5 is a longitudinal sectional view showing the vane-type fluid machine having the single vane structure of FIG. 4 and additionally having a drive-side pin-crank shaft structure and a bearing structure of a undriven-side rotor flange.

[0038] For the vane-type fluid machine in FIG.5, basically the same reference characters as in FIG.1 showing the first embodiment of the present invention are allotted to the same members or portions as in FIG.5, and iterative descriptions are omitted hereinafter.

[0039] Referring to FIGS, a rotor 4 concentrically having a drive-side rotor flange 4a is eccentrically assembled in a casing 1 through a drive-side sidecover 2 and rotatably supported by a bearing 16 accommodated in a boss portion of the drive-side sidecover 2. A main shaft 6d, having the B-axis with an eccentricity 2/m from the rotor center Y1-axis, of a drive-side pin-crank shaft is supported by a pin-crank rotor 8 with a bearing 11. The pin-crank rotor 8 is accommodated in a drive-side end portion of the rotor 4 and is rotatable around the Y1-axis. An auxiliary shaft 6a of the drive-side pin-crank shaft is inserted in a vane drive-side edge-to-edge span center along with a bearing 13 and an oil-seal 14 for a vane-inside grease reservoir 5a. The vane 7 is slidably inserted in a rotor groove 4B. An undriven-side rotor flange 4d is concentrically assembled with the rotor 4 and rotatably supported by an undriven-side sidecover 3 through a bearing 20b. A main shaft 19 of an undriven-side pin-crank shaft is rotatably supported by a housing 15 through a bearing 20a on the A-axis which is positioned in the middle between the Y-axis of the casing and the Y1-axis of the rotor, that is, the A-axis has the eccentricity of m/2 from the Y1-axis. An auxiliary shaft 19a of the undriven-side pin-crank shaft is inserted in the vane 7 through a bearing 21 in the vane edge-to-edge span center on the undriven-side. A reference character 4f indicates a grease reservoir which, along with a grease hole (not shown), is utilized to lubricate the vane 7 in case of grease lubrication.

[0040] Next, FIG.6 shows a modified embodiment of a second embodiment of the vane-type fluid machine in accordance with the present invention.

[0041] For the vane-type fluid machine in FIG.6, basically the same reference characters as in FIG.5 showing the second embodiment of the present invention are allotted to the same members or portions as in FIG.6, and iterative descriptions are omitted hereinafter.

[0042] FIG.6 is a longitudinal sectional view showing the modified embodiment having a straight orbiting shaft, wherein a vane is in a horizontal state.

[0043] Referring to FIG.6, one end of a rotor 4 eccentrically accommodated in a casing 1 is rotatably inserted along with a bearing 14 in a boss portion of a drive-side sidecover 2 assembled to the casing 1. One side of an orbiting shaft 6 is fixedly inserted axially in a vane 7 in the vane edge-to-edge span center. A reference character 6a indicates a rotation preventing key of an orbiting shaft 6a against the vane 7. A bearing portion 6b of the orbiting shaft 6 is rotatably supported by an orbiting shaft fitting rotor 10 through a bearing 8 on the Y1-axis having the eccentricity of m/2 from the A-axis being the center of the orbiting shaft fitting rotor 10. The orbiting shaft fitting rotor 10 with a bearing 11 is accommodated in an undriven-side sidecover 3 rotatably on the A-axis having the eccentricity of m/2 from the Y-axis being the casing center. The vane 7 is slidably inserted in a rotor groove 4B. The drive shaft 5 is inserted in a boss portion of the rotor 4.

[0044] Finally, form of the casing inner periphery of the present invention is described with reference to FIG. 7. Referring to this drawing, a dimension L, i.e. 2L on both sides of point G, is fundamental for deciding the casing inner periphery. The orbital circle h is formed with the radius m/2 based on the eccentricity m of the rotor with respect to the casing. When the vane rotates in an angle α, the vane center G shifts to a point P. A length G-Z is calculated as ($m \sin \alpha + L$) and also a length G-V is calculated as ($L - m \sin \alpha$). And, the coordinates of the point Z is: $Xz = (m\sin \alpha + L)\cos(90° - \alpha)$; and $Y1z = (m\sin \alpha + L)\cos \alpha$, and also the coordinates of the point V is: $Xv = (L - m\sin \alpha)\cos(90° - \alpha)$; and $Y1v = (L - m\sin \alpha)\cos \alpha$. The casing inner periphery R can be obtained by getting the points Z and V according to the angle α as a variable.

[0045] Although the present invention has been fully described by way of examples with reference to the accompanying drawings, it is to be noted that various changes and modifications will be apparent to those skilled in the art. Therefore, unless otherwise such changes and modifications depart from the scope of the present invention, they should be construed as being included therein.

Claims

1. A vane-type fluid machine comprising:

> a casing with a sidecover, said casing having a contacting-surface circular arc on an inner periphery thereof;
>
> a rotor eccentrically fitted in said casing with a predetermined eccentricity, said rotor having a diameter to form a sealing surface with respect to the contacting-surface circular arc formed on the inner periphery of said casing for keeping seal between a suction side and a discharge side and said rotor having a rotor discharging groove on an outer surface thereof;
>
> a vane slidably inserted in a rotor groove formed on said rotor so that an edge of said vane proceeds along the inner periphery of said casing on rotation of said rotor; and

a drive shaft inserted in a boss portion of said rotor concentrically with said rotor for rotating said rotor,
wherein, with rotation of said rotor, fluid is sucked into a space formed in said casing with an inner surface thereof, the outer surface of said rotor, and said vane, and simultaneously fluid in another space formed in said casing is compressed, while being discharged from a discharge hole provided on the contacting-surface circular arc through the rotor discharging groove.

2. The vane-type fluid machine as claimed in claim 1, further comprising:

an orbiting shaft fitting rotor accommodated in the sidecover on the undriven-side rotatably around an axis positioned in the middle of axes of said casing and of said rotor; and
a partition provided on a bottom portion of the rotor groove,
wherein said vane slidably inserted in the rotor groove formed on said rotor is made up of a pair of vane members connected by a connecting member keeping a fixed edge-to-edge span of said pair of vane members and having an orbiting shaft outwardly in the center of the edge-to-edge span of vane members, said orbiting shaft being rotatably fitted into said orbiting shaft fitting rotor with half of the predetermined eccentricity and orbiting the axis of said orbiting shaft fitting rotor.

3. A vane-type fluid machine comprising:

a casing with an undriven-side sidecover;
a rotor eccentrically fitted in said casing with a predetermined eccentricity;
a vane slidably inserted in a rotor groove formed on said rotor so that an edge of said vane proceeds along an inner periphery of said casing on rotation of said rotor;
a drive shaft inserted in a boss portion of said rotor concentrically with said rotor for rotating said rotor; and
a pin-crank shaft having an eccentricity of half of the predetermined eccentricity and set between an undriven-side end of said vane and the undriven-side sidecover, wherein one end of said pin-crank shaft is rotatably fitted into said vane in its edge-to-edge span center and the other end is fitted into the undriven-side sidecover also rotatably around an axis positioned in the middle of axes of said casing and of said rotor so that an axis of the one end of said pin-crank shaft orbits the axis of the other end thereof with a radius of half of the predetermined eccentricity,
wherein, with rotation of said rotor, fluid is sucked into a space formed in said casing with an inner surface thereof, the outer surface of said rotor, and said vane, and simultaneously fluid in another space formed in said casing is compressed, while being discharged from a discharge hole.

4. The vane-type fluid machine as claimed in claim 3, wherein

said casing has a contacting-surface circular arc on an inner periphery thereof,
said rotor has a diameter to form a sealing surface with respect to the contacting-surface circular arc formed on the inner periphery of said casing for keeping seal between a suction side and a discharge side and has a rotor discharging groove on an outer surface thereof, and
said discharge hole is arranged on the contacting-surface circular arc so that said fluid in said another space flows through the rotor discharging groove to said discharge hole.

5. A vane-type fluid machine comprising:

a casing with sidecovers;
a rotor eccentrically fitted in said casing with a predetermined eccentricity;
a vane slidably inserted in a rotor groove formed on said rotor so that an edge of said vane proceeds along an inner periphery of said casing on rotation of said rotor;
a drive shaft inserted in a boss portion of said rotor concentrically with said rotor for rotating said rotor; and
an undriven-side rotor flange concentrically assembled with said rotor on an undriven-side thereof so that both sides of said rotor are rotatably supported by the respective sidecovers through bearings,
wherein, with rotation of said rotor, fluid is sucked into a space formed in said casing with an inner surface thereof, the outer surface of said rotor, and said vane, and simultaneously fluid in another space formed in said casing is compressed, while being discharged from a discharge hole.

6. The vane-type fluid machine as claimed in claim 5, wherein

said casing has a contacting-surface circular arc on an inner periphery thereof,
said rotor has a diameter to form a sealing surface with respect to the contacting-surface circular arc formed on the inner periphery of said

casing for keeping seal between a suction side and a discharge side and has a rotor discharging groove on an outer surface thereof, and said discharge hole is arranged on the contacting-surface circular arc so that said fluid in said another space flows through the rotor discharging groove to said discharge hole.

7. A vane-type fluid machine comprising:

a casing with an undriven-side sidecover;
a rotor eccentrically fitted in said casing with a predetermined eccentricity;
a vane slidably inserted in a rotor groove formed on said rotor so that an edge of said vane proceeds along an inner periphery of said casing on rotation of said rotor;
a drive shaft inserted in a boss portion of said rotor concentrically with said rotor for rotating said rotor;
an orbiting shaft fitting rotor accommodated in the undriven-side sidecover rotatably around an axis positioned in the middle of axes of said casing and of said rotor; and
an orbiting shaft set between an undriven-side end of said vane and said orbiting shaft fitting rotor, wherein one end of said orbiting shaft is fixedly inserted into said vane in its edge-to-edge span center and the other end is fitted into said orbiting shaft fitting rotor with half of the predetermined eccentricity,
wherein, with rotation of said rotor, fluid is sucked into a space formed in said casing with an inner surface thereof, the outer surface of said rotor, and said vane, and simultaneously fluid in another space formed in said casing is compressed, while being discharged from a discharge hole.

8. The vane-type fluid machine as claimed in claim 7, wherein

said casing has a contacting-surface circular arc on an inner periphery thereof,
said rotor has a diameter to form a sealing surface with respect to the contacting-surface circular arc formed on the inner periphery of said casing for keeping seal between a suction side and a discharge side and has a rotor discharging groove on an outer surface thereof, and said discharge hole is arranged on the contacting-surface circular arc so that said fluid in said another space flows through the rotor discharging groove to said discharge hole.

9. The vane-type fluid machine as claimed in claim 1, wherein

a grease reservoir and a grease hole connecting the grease reservoir with said vane are formed inside said rotor so as to lubricate said vane through the grease hole.

10. The vane-type fluid machine as claimed in claim 3, wherein

a grease reservoir and a grease hole connecting the grease reservoir with said vane are formed inside said rotor so as to lubricate said vane through the grease hole.

11. The vane-type fluid machine as claimed in claim 5, wherein

a grease reservoir and a grease hole connecting the grease reservoir with said vane are formed inside said rotor so as to lubricate said vane through the grease hole.

12. The vane-type fluid machine as claimed in claim 7, wherein

a grease reservoir and a grease hole connecting the grease reservoir with said vane are formed inside said rotor so as to lubricate said vane through the grease hole.

13. The vane-type fluid machine as claimed in any one of claims 1-8, wherein

on the coordinates (X,Y1) with the origin of an axis of said rotor, a point (Xz,Y1z) on one part of an inner periphery of said casing is determined by the following equations of

$$Xz = (m\sin\alpha + L)\cos(90° - \alpha)$$

and

$$Y1z = (m\sin\alpha + L)\cos\alpha,$$

and a point (Xv,Y1v) on the remaining part of the inner periphery of said casing is determined by the following equations of

$$Xv = (L - m\sin\alpha)\cos(90° - \alpha)$$

and

$$Y1v = (L - m\sin\alpha)\cos\alpha,$$

wherein m is the predetermined eccentricity, α

is rotation angle of said vane, and L is half of an edge-to-edge span of said vane.

14. A casing for a vane-type fluid machine which consists of said casing with an sidecover, a rotor eccentrically fitted in said casing with a predetermined eccentricity, a vane slidably inserted in a rotor groove formed on said rotor, and a drive shaft concentrically connected to said rotor for rotating said rotor,

wherein, on the coordinates (X,Y1) with the origin of an axis of said rotor, a point (Xz,Y1z) on one part of an inner periphery of said casing is determined by the following equations of

$$Xz = (m\sin\alpha+L)\cos(90°-\alpha)$$

and

$$Y1z=(m\sin\alpha+L)\cos\alpha,$$

and a point (Xv,Y1v) on the remaining part of the inner periphery of said casing is determined by the following equations of

$$Xv =(L-m\sin\alpha)\cos(90°-\alpha)$$

and

$$Y1v=(L-m\sin\alpha)\cos\alpha,$$

wherein m is the predetermined eccentricity, α is rotation angle of said vane, and L is half of an edge-to-edge span of said vane.

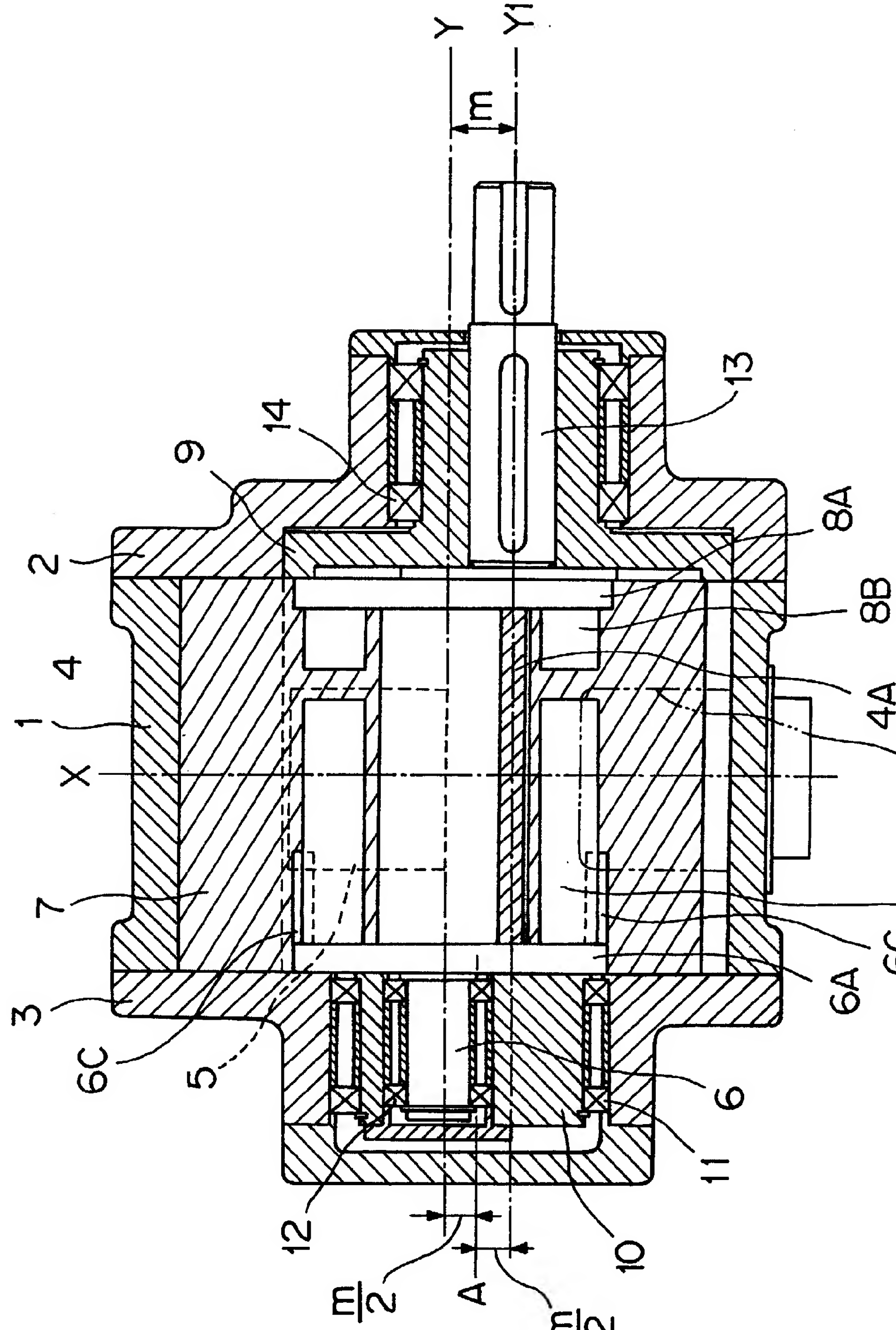
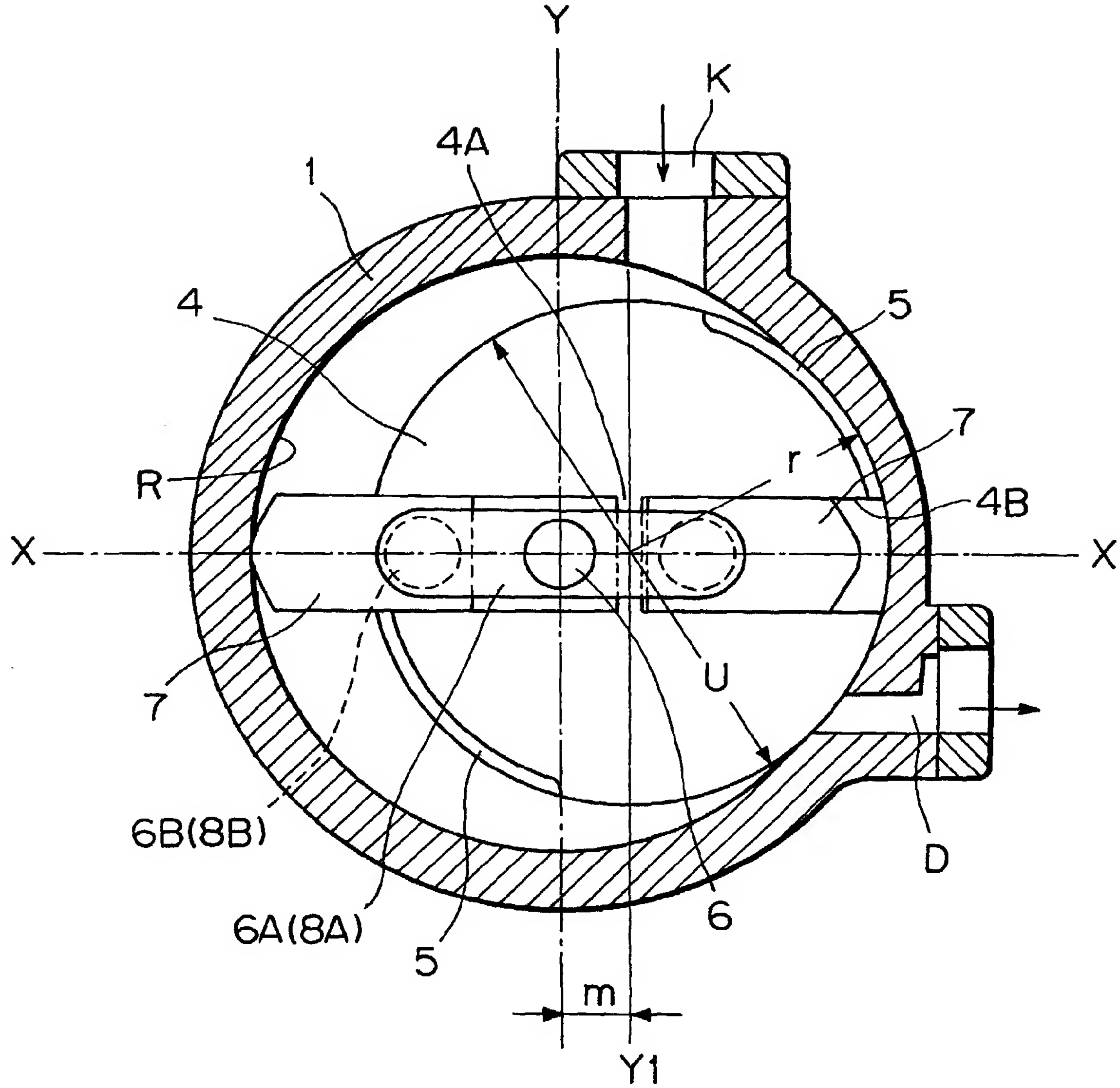
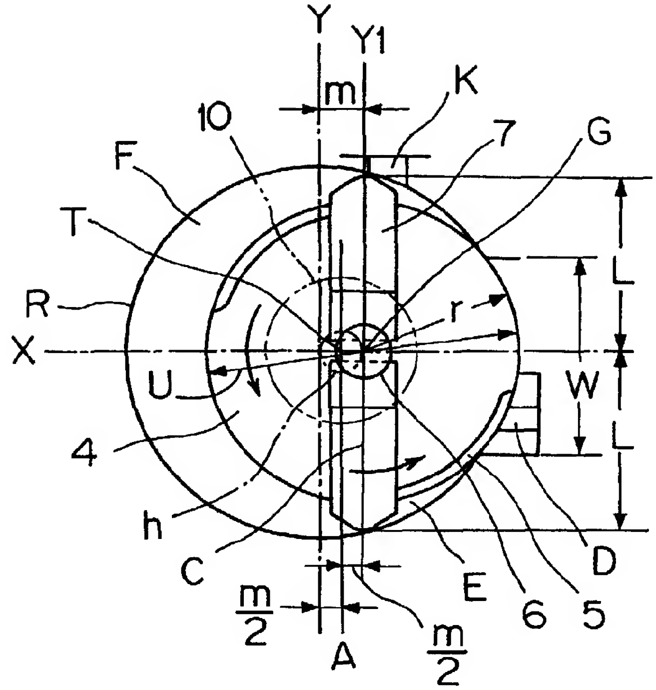


FIG. 1

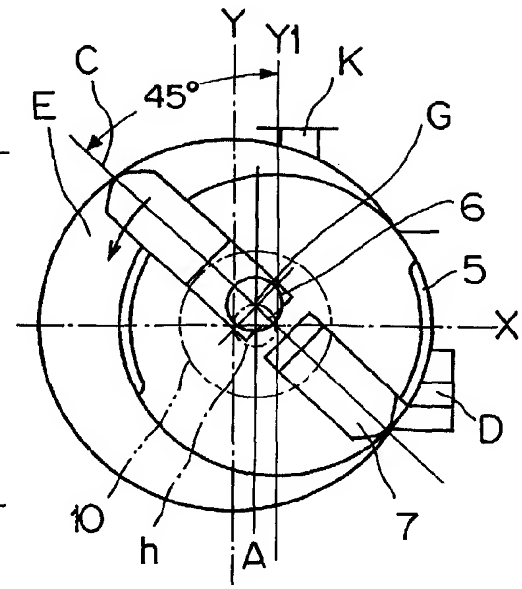


F I G. 2



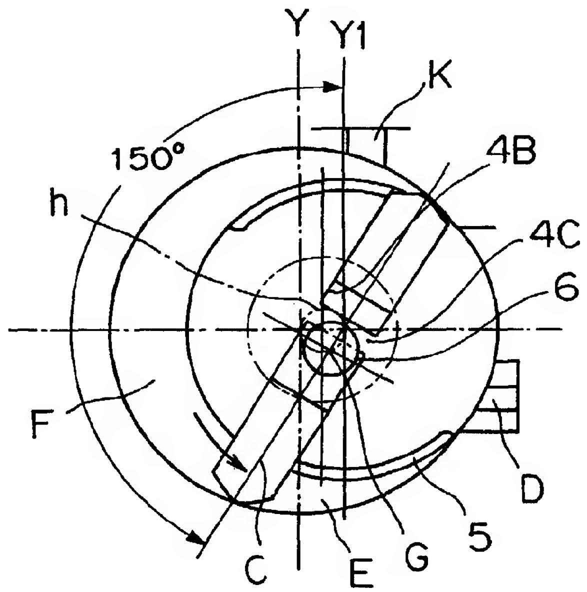
(0°, 180°)

FIG. 3A



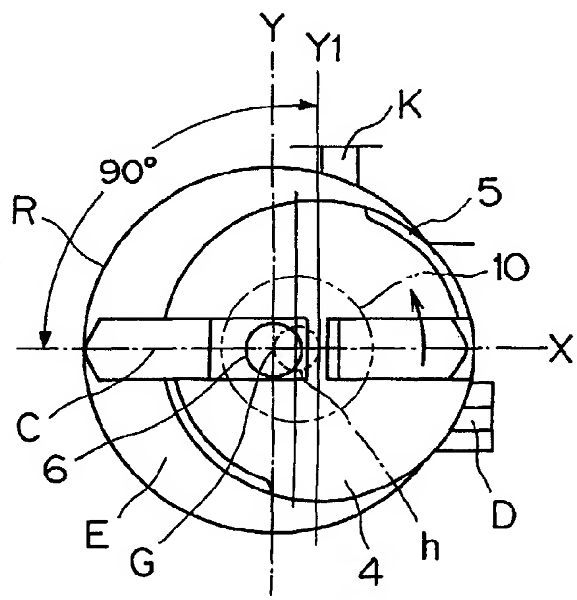
(45°)

FIG. 3B



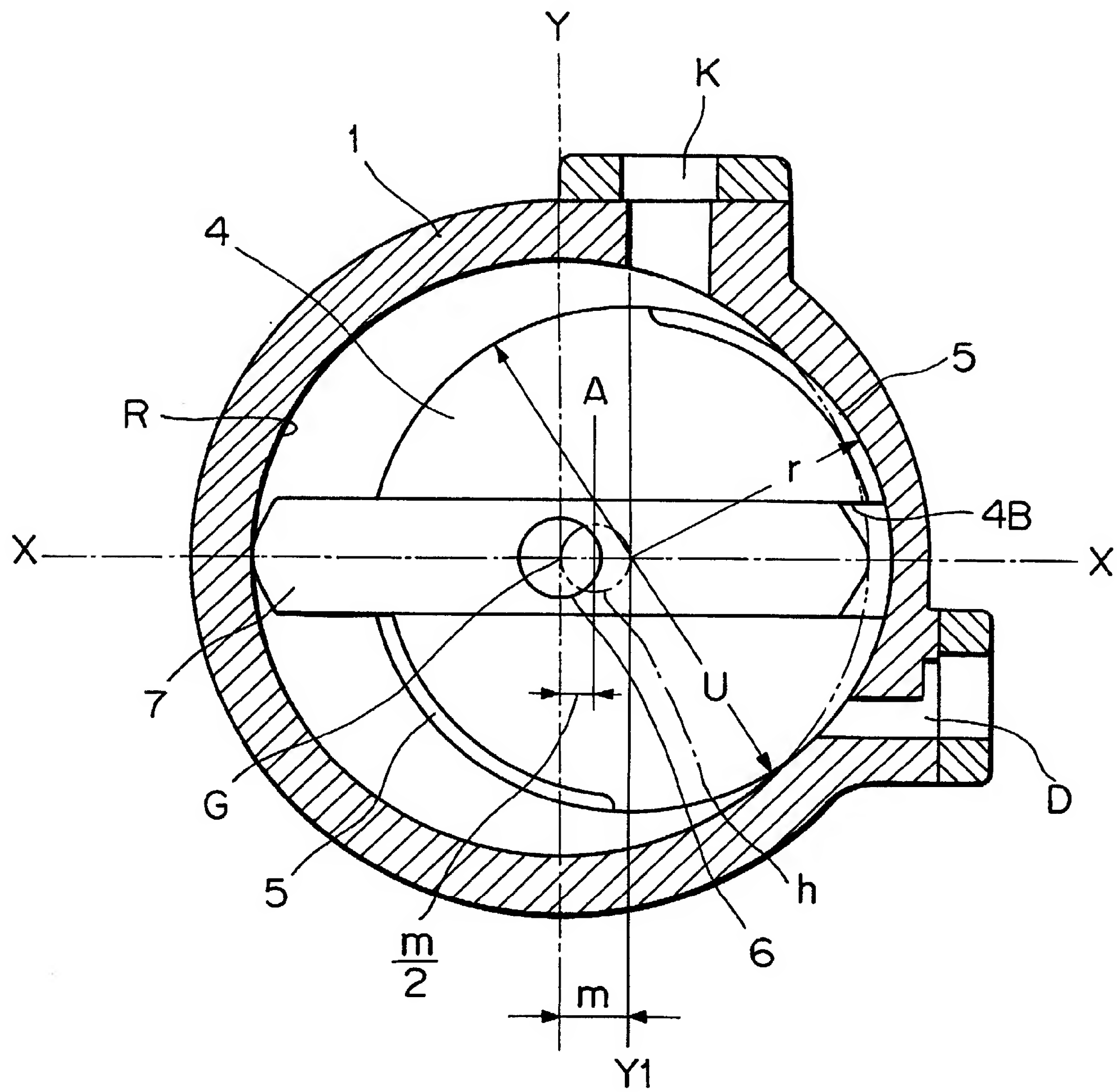
(150°)

FIG. 3D



(90°)

FIG. 3C



F I G. 4

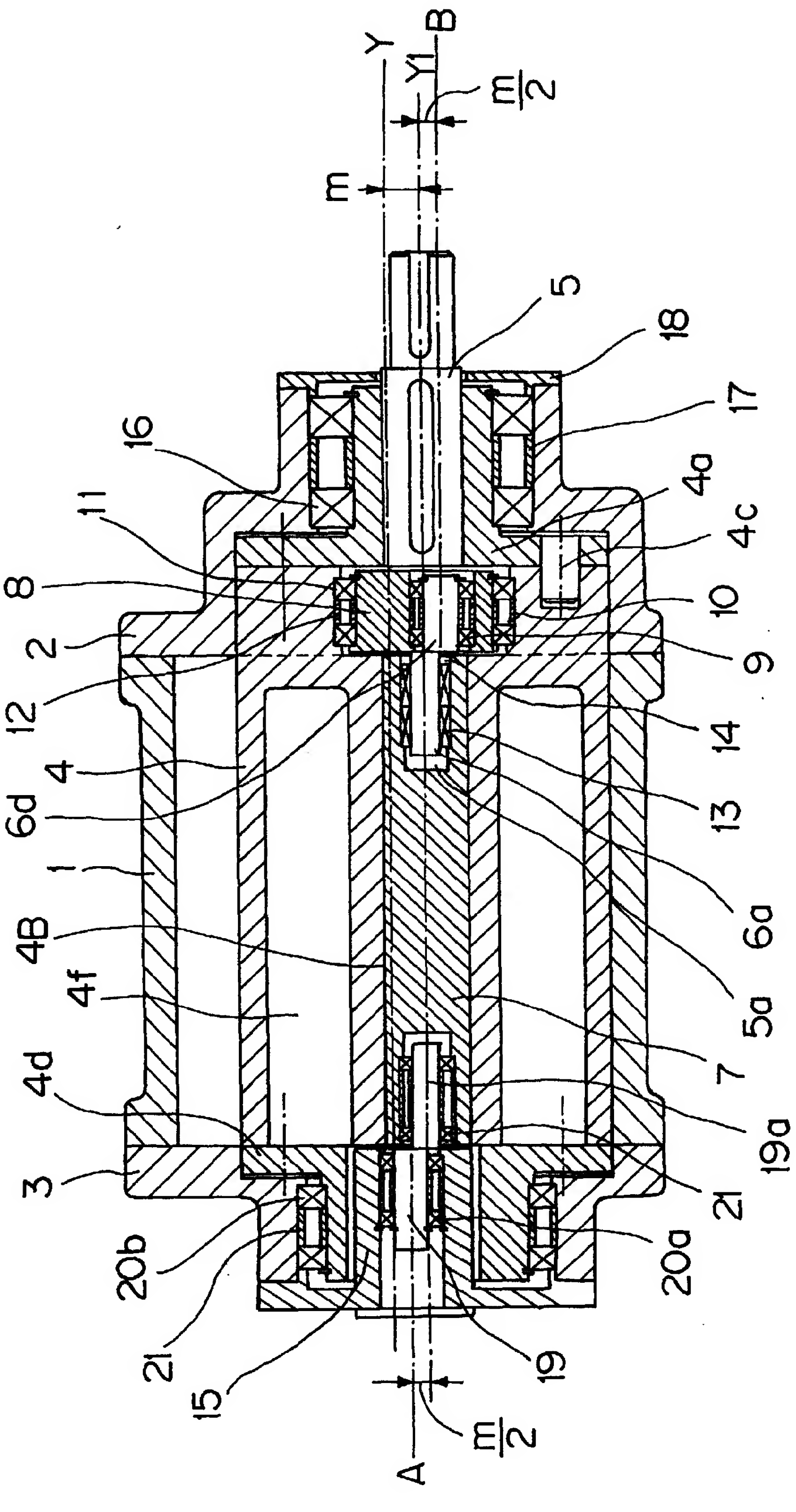

Y
Y1
B
m
m/2
5
18
17
16
4a
4c
11
8
10
2
9
12
14
4
13
6d
6a
1
5a
4B
4f
7
4d
19a
3
21
20b
20a
21
15
19
m/2
A

FIG. 5

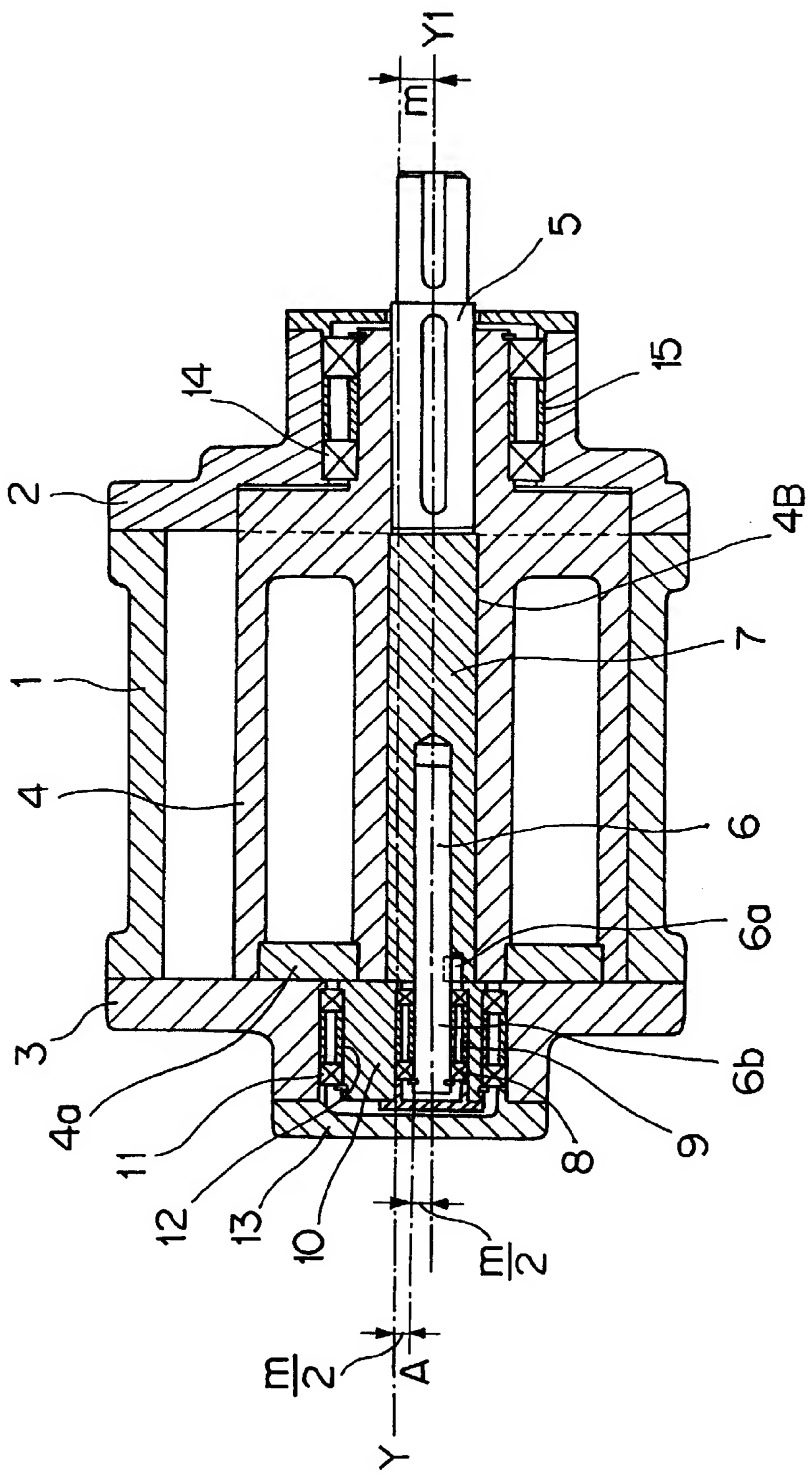
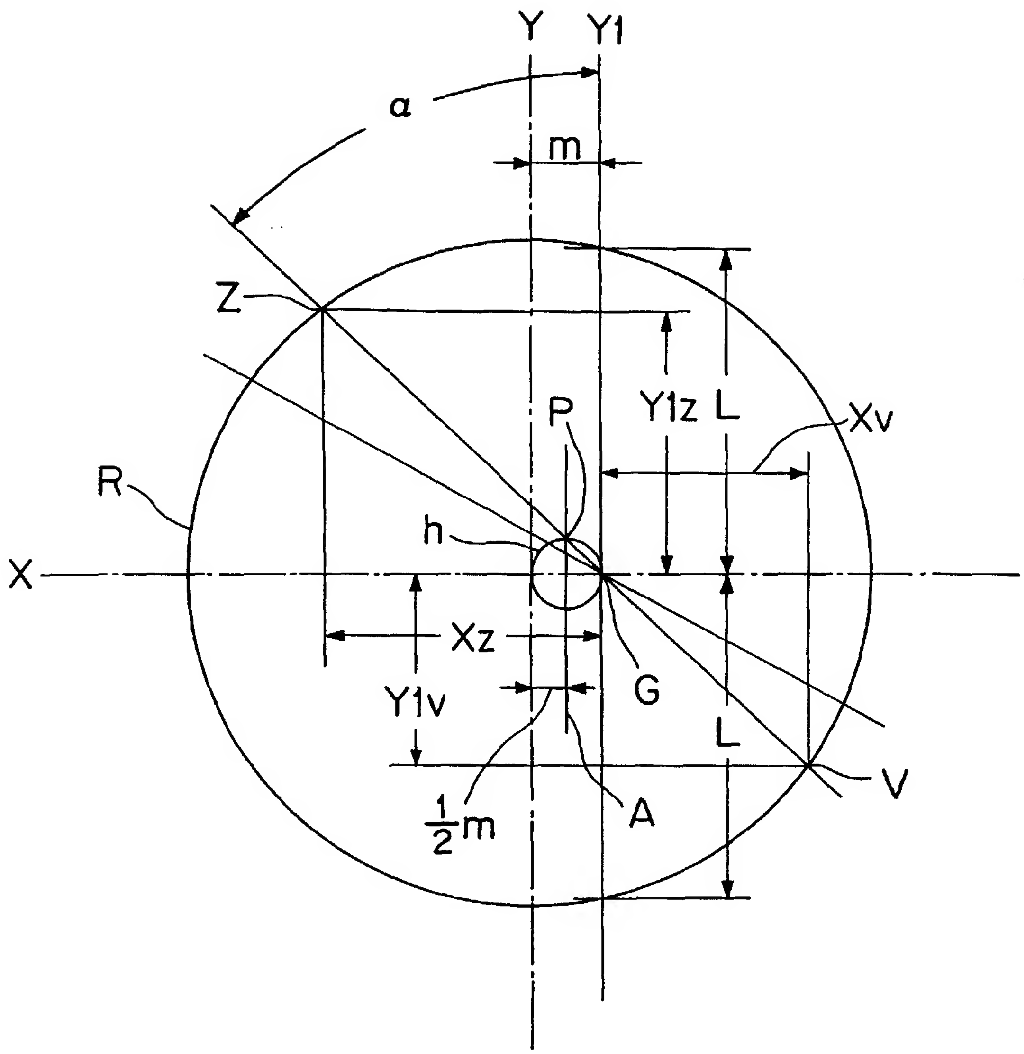


FIG. 6



F I G. 7

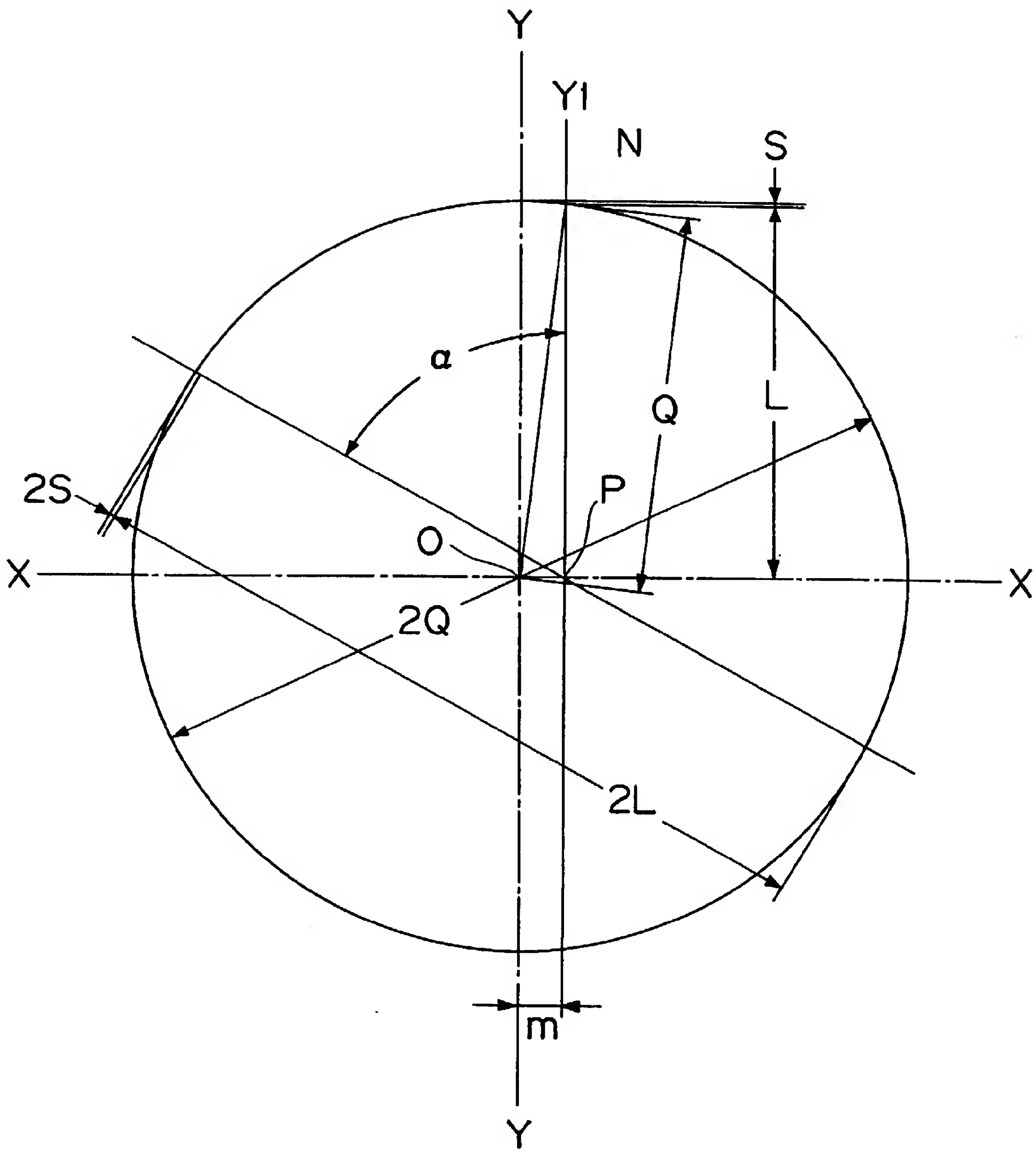


FIG. 8